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The invention refers to a method to manufacturing engraved rollers and panels for the flexographic printing, low pressure, coining/shaping and coating with a base body made of metal, whose surface will provide a film of a Metalles or a metal compound with an engraving according to a desired pattern and at least for the increase of the resistance to wear and the corrosion resistance on the engraved surface of the base body is applied.

The covering of articles of metal with a protective layer for the increase of the corrosion resistance and the hardness and the resistance to wear is for a long time well-known. In particular metallic objects on basis iron, steel or such a thing are usually covered for nickel or chromium on galvanic of ways or by chemical reduction with a metallic coating out for example. After these galvanic methods verschleissfeste surfaces on metallic base bodies with Vickers hardnesses up to approximately 950 HV with nickel layers or 1200 HV can be obtained with chromium layers with nickel or chromium layers.

The moreover it is well-known to evaporate hard material layers in a vacuum method on metallic or non-metallic surfaces of bodies in order to equip these verschleissfest. With the CVD process - chemical deposition from the vapor phase - the metallic portion must be set free only from a gaseous starting material by Cracken, before the metal reacts with the gas. The CVD process needs high reaction temperatures from 800 to 1100 DEG C.

With the PVD procedure - physical deposition from the vapor phase - the metal vapor is produced directly and reacted on the surface of the body which can be coated with the gas for the desired hard material layer. The PVD procedure makes that for separating possible of hard materials for the formation of a wear course at temperatures between 200 DEG C and 650 DEG C.

Provided rollers or plates represent a special field for manufacturing products with verschleissfesten surfaces with engravings, which find as form die impacts, Druckwerkzeuge or coating tools application. Usually the rolling or disk body is manufactured for this from steel, so that improving of the surface are necessary for the increase of the corrosion protection and the resistance to wear. Such engraved rollers and sheets were only realized so far with verschleissfesten surfaces with high hardness over 1700 HV on basis ceramic coated base body, whereby the engraving is trained by laser beams according to the desired embossing sample into the surface. Ways of the numerous parameters which can be considered with the treatment from ceramic bodies to however the engravings are not 100%-ig reproducible, so that each engraved roller or panel precipitates with original the same engraving slightly differently. For many applications it is however necessarily, uselessly, because worn out, to replace become form die impact or printing plates by new form die impacts or printing plates with identical embossing sample.

From the DE 40 08 254 A1 already the equipment of engraved rollers or sheets with a base body made of metal, like steel, is well-known, which is provided with a verschleissfesten top layer from a hard material layer applied in the PVD procedure. As unfavorable here considered becomes for some patterns that the patterns on the metal, i.e. in particular steel of the base body, to be engraved to have.

The invention is the basis the object, engraved rollers and panels for the flexographic printing, low pressure, to equip a coining/shaping or a coating with very resolution of the patterns and wear courses of high hardness from at least 2000 HV, fine in particular, to Vickers which are with high precision reproducible and engravable.

For the solution of the object posed a method is suggested according to invention to manufacturing engraved rollers or sheets with high wear resistance of the genericin accordance with-eaten kind, with that

a) the base body is coated with an engraving layer, selected from or several of the metals copper, tin, zinc, brass, bronze, nickel, manganese, gold, silver, lead in a thickness from at least 0.5 mm to 1.7 mm,
b) then after cleaning the desired embossing sample is engraved on the engraving layer mechanical, electromechanically, by means of lasers or by means of corrosion,
c) then the base body cleaned provided with the engraving layer and the engraving is polished and,
d) afterwards on the engraved surface of the engraving layer of the base body an intermediate layer of a thickness from 5 to 25 mu m and an hardness from at least 850 HV to Vickers one applies, which becomes afterwards polished and cleaned,
e) on this intermediate layer of the base body a wear course from a metal compound with an hardness after Vickers of at least 2000 by vapor deposition in the vacuum after the PVD procedure at temperatures from 200 to 480 DEG C in a thickness from 4 to 8 mu m one applies,
f) and after cooling the surface of the base body provided with the vapor deposited wear course is polished.

The method according to invention makes the element possible of low-priced base bodies made of metal, like steel, for the preparation of engraving rollers or engraving plates for the flexographic printing or low pressure or for the formation of coating rollers or such a thing, since for the engraving an engraving layer made of suitable metals on the base body, suitable for training an engraving, is applied. The metals selected for the engraving layer, like z. B. Copper, nickel, bronze, brass exhibit partially quite small hardness, so that it as layer of engraving rollers or - plates because of the quick wear, high abrasion and deformation inappropriate are. On the other hand they permit a manufacturing of engravings with high resolution of 40000 holes and more on a surface of 1 cm< 2> with depths of the holes of for

example 16 mu m with high accuracy. The engraving layer is applied in a sufficient thickness by at least 0.5 mm on the base body. Preferred the engraving layer with methods of the galvanotechnics is applied, D. h. the electrolytic deposition of metals in thin films. To the deposition of the metal coats for the engraving layer the mechanical are hung up, chemically or electrochemical prepared articles as cathode into the solution (galvanic bath), the salts of the metal which can be separated and further components contain. Metal at the cathode is separated by direct current with 1 to 15 V and an appropriate quantity of the anode is solved. For example a copper layer is applied usually galvanically, as preceding described. Belonged to the galvanotechnics likewise the metal separation without outside power source, whereby unedle materials can be covered with nobler metals thinly, by dipping the materials into suitable solutions of the nobler metal usually at higher temperature. One knows thicker coatings also with reducing agents, as formaldehyde, Hypophosphit or sodium boron hydride to separate, then know likewise silver plating and Verkupferungen or nickel plating are manufactured. For the achievement of a well adherent galvanic engraving layer must be treated which can be galvanized the base body before bringing in in the galvanizing bath thoroughly cleaned and with the agents of the metal defatting in well-known way.

It is also possible, the engraving layer in shape of a prefabricated moulded product, as tube out for the example brass or copper or plate from brass or copper on the base body to apply for the example from steel or iron of appropriate form - roller or plate -. It is also possible, for base bodies and engraving layer from the same material to finished, D. h. for the example copper, so that base bodies and engraving layer form a unit.

Preferential engraving layers are manufactured made of copper, a thick nickel layer or brass or a bronze.

With the method according to invention it is possible to provide and at the same time corrosion resistant and with high resistance to wear to equip rollers and plates with very line precise engravings. The special advantage of the invention is to be seen however therein that the method is reproducible, D. h. engraved rollers or panels with same engraving after the method according to invention verschleissfest without deviations to be from each other equipped know, D. h. reproducibly to be manufactured can. Engraved rollers or plates resemble together are thereby in the exchange for worn out engraved rollers and plates with same pattern for high service lives and life with a high hardness after Vickers of over 2000, preferably over 2500 HV producible.

The base body is equipped with one particularly for the engraving suitable engraving layer and then with the further increase of the corrosion resistance and the resistance to wear serving layers, at least two further layers, according to invention. Here for the base body of materials of high strength, accuracy to size and economy intended, like iron, steel, however not corrosion resistant are different and of the materials particularly suitable for engraving. Favourable embodiments of the method according to invention to manufacturing engraved rollers or panels for the flexographic printing, low pressure, coining/shaping or coating are entnehmbar the characteristic features of the Unteransprüche.

The intermediate layer applied on the engraving layer takes over the function of a corrosion protection for the engraving layer and the metallic base body, whereby the intermediate layer applied on the engraving layer provided with the engraving should be as close and homogeneous as possible and exhibit a relatively high hardness. Depending on made of whatever metal or metals the intermediate layer, can this still another annealing with the goal of a re-hardening is developed for the increase of the hardness is submitted.

As intermediate layer becomes a auto+catalytic separated nickel phosphorus alloy with a Phosphorgehalt from 5 to 13 Gew. - %, preferably 8 to 13 Gew. - % prefers. The intermediate layer essentially consists of nickel. This is usually called ?chemically? nickel. After the applying of the intermediate layer prefers a cleaning and an annealing treatment of in such a way coated base body made. In particular a following thermal treatment in the vacuum causes a purifying and a degassing of the intermediate layer and an annealing, D. h. a further cure for the example of applied nickel phosphorus alloy, so that by this secondary hardening an hardness of this intermediate layer is reached by preferably at least 900 HV.

An intermediate layer from a nickel phosphorus alloy is annealed preferentially in the vacuum at temperatures over 240 DEG C up to 350 DEG C during a duration from 1 to 3 hours. In a preferential embodiment of the method according to invention annealing of the base body provided with the intermediate layer and the vapor deposition of the wear course become continuous successively performed, whereby the vapor deposition of the wear course attaches directly to the annealing with retention or increase of the annealing temperature. This method can become thereby for example in the same vacuum chamber in trains with annealing and applying the wear course from hard materials performed.

The annealing time of the base body with intermediate layer depends on the value and the dimensions of the roller or panel. Smallest engraving rollers have a diameter of 10 mm with a smallest length of 20 mm, largest engraving rollers have a diameter of over 500 mm with lengths up to 3500 mm. Similarly it behaves with engraving plates.

Another intermediate layer, which exhibits high surface hardness already from the beginning, is such from ceramic(s) on basis of Siliziumcarbiden, which is sprayed on as thin film on the surface of the engraving layer of the base body provided with the engraving.

With the method according to invention in particular high hardnesses of the wear courses later which can be laid on can be achieved also by the fact that already the intermediate layer exhibits a high hardness. Around the precision of the embossing sample, D. h. the thickness of the intermediate layer and the thickness of the wear course are upward limited for the engraving, too received. The sum of the thickness of these layers should be larger in no case than 30 mu m, since otherwise geometry of the patterns and engravings is changed excessively and so that the reproductibility is questioned.

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The thickness of the intermediate layer and the wear course is downward limited, in order to receive still another sufficient close layer. With layer thickness of approximately 8 mu m also an intermediate layer from nickel can be for example still minimum porous, however this porosity is eliminated by those wear course which can be evaporated in the following, since the material of the wear course diffuses a closed and into the intermediate layer and with this then coating layer corrosion resistant forms. Since the wear course is applied by vapor deposition in the vacuum at increased temperatures, the intermediate layer from a material is to be selected, which withstands also these temperatures, whereby nickel and ceramic(s) worked satisfactorily as base material for the intermediate layer. The engraving layer is here protected by the applied intermediate layer.

It is also possible, an intermediate layer from a first on the base body auto+catalytic separated coating of a nickel phosphorus alloy with a Phosphorgehalt from 3 to 13 thread. - to form % in a layer thickness from 4 to 8 mu m and a

second on that electrolytically separated layer of chromium with a layer thickness from 4 to 8 mu m. A such two-layered intermediate layer has the advantage that the nickel layer forms a homogeneous close layer, while on that applied chromium layer is not so close thus a higher micro porosity exhibits, however a higher hardness after Vickers up to 1200 HV exhibits than nickel. The higher the hardness of the intermediate layer is, the more highly becomes also the attainable hardness of the wear course which can be evaporated on that.

For the wear course prefers Metallboride, - carbide, - nitrides, - oxides, - silicide of the elements fourth to sixth Nebengruppe of the periodic system titanium, zircon, hafnium or vanadium, niobium, tantalum or chromium, molybdenum, tungsten individually or in combinations begun. Preferred for the wear course the carbides, are used nitrides and oxides of the elements of the fourth Nebengruppe of the periodic system which are particularly characterised by hardness and wear-resisting quality. For example for the wear course titanium nitride or titanium aluminum Carbonitrid or titanium aluminum nitride or titanium Carbonitrid or titanium carbide is used. With these so-called hard materials for the wear course, which are applied after the PVD procedure on the engraving or embossing samples of a base body provided with the intermediate layer, are attainable hardnesses from 2500 to 3000 HV. Suitably is also Hafniumborid, which is characterised by a Vickers hardness of approximately 3200.

The wear course becomes vapor deposited in a thickness from 4 to 8 mu, preferred 5 to 7 mu m. With formation of the intermediate layer from nickel and a chromium layer these should not together exceed a thickness of 15 mu m. Chromium exhibits a higher hardness than nickel, has however the disadvantage that it already dissolves at procedure-moderately the temperatures which can be used to the vapor deposition of the wear course and becomes porous. There it however according to invention on an underlay from nickel, D. h. Nickel phosphorus alloy is used, can catch this nickel phosphorus alloy the temperature influence on the chromium and stabilize the chromium layer. Simultaneous one receives however this intermediate layer by the chrome edition a altogether higher hardness and resistance to wear than to nickel phosphorus an alloy layer alone.

The rollers and plates provided after the method according to invention producible with an engraving or a embossing sample are reproducibly producible and point a high resistance to wear, D. h. essential lengthened service life and an hardness of at least about 2000 HV depending upon kind of the vapor deposited metal hard material connection up.

With according to invention suggested the preferential deposition of an intermediate layer from nickel phosphorus an alloy a very homogeneous close layer is reached. Here it concerns a prior art method the auto+catalytic or external currentless nickel phosphorus Legierungsabscheidung. In the chemical Nickelbad reducing agents are, Sodium phosphinate are mostly used beside nickel ions. From this bath become then nickel phosphorus alloys with Phosphorgehalten between 3 to 13 Gew. - % separated.

After the method according to invention engraved rollers or surfaces for printing processes can be equipped with very high resolution of the embossing samples and engravings with high accuracy verschleissfest.

The invention is exemplarily described in the following in the design. Show

Fig. 1 schematically in the cross section the structure of an engraved plate

Fig. 2 schematically in the cross section the structure of an engraved plate with two-part intermediate layer.

The base body 1 for the example of a form die impact made of metal, like steel, or a non-ferrous metal, for example a brass or a bronze, exhibits the basic form of a Kubus for an engraving plate or a tube with very large wall thickness or cylinder for the preparation of an engraving roller. On the surface of this base body 1 now preferentially on galvanic of ways an engraving layer 2 in a sufficient thickness, to the example a copper layer by 1.1 mm, is applied sees Fig. 1. Before the applying of the engraving layer 2 the base body thoroughly cleaned is treated and with agents for metal defatting. Afterwards the engraving layer 2 of the base body 1 in the desired ranges according to the desired pattern with the engraving 3 on mechanical, electromechanical way or by means of corrosion is provided. So the base bodies provided with the engraving 3 after cleaning and polishing afterwards at least in the range of the engraved surface with an intermediate layer 4, covered for example for auto+catalytic separated nickel phosphorus alloy layer 4 in a thickness is coated by 12 mu m. Afterwards effected cleaning and Polliervorgang. Dann so the base bodies 1 provided with the intermediate layer 4 to the secondary hardening and following vapor deposition of a wear course into a vacuum chamber and slowly in the vacuum to the annealing temperature by approximately 350 DEG C warmed up and at this annealing temperature during 2.5 hours maintained is brought in and directly afterwards the wear course 5 as extreme layer by vapor deposition of an appropriate metallic hard material connection, for example for titanium nitride in the vacuum at temperatures up to 480 DEG C after the PVD procedure on the intermediate layer applied. The hard material layer made of titanium nitride is applied for example in a thickness by 7 mu m. If no annealing step in the vacuum precedes, on ambient temperature which are coated, engraved and cleaned and polished base bodies 1, 2, 3, 4 slowly in the vacuum heated up to the appropriate temperature of for example 480 DEG C for the vapor deposition of the hard material layer. After the cooling in such a way of the base body 1 after the vapor deposition of the layer 5, equipped with the films 2, 4, 5 and the engraving 3, also the vapor deposited layer is superficially polished. Thus is the engraved sheet or roller with a verschleissfesten layer from titanium nitride with an hardness of approx. 3000 HV equipped. This engraved roller or panel is reproducibly producible after this method.

With in the Fig. 2 represented ausschnittweise schematic structure of an engraved plate or roller is the base body 1 likewise with the engraving layer 2 and herein the engraving 3 provided. A first intermediate layer 4a from a nickel phosphorus alloy auto+catalytic is separated on that in a layer thickness of approximately 5 mu M. If necessary after necessary purification processes on that electrolytically a chromium layer 4b in a thickness is laid on by 5 mu m. After prepurifying and polishing afterwards by thermal treatment in the vacuum at temperatures to 340 DEG C these intermediate layers 4a, 4b cleaned, and directly afterwards, are degassed and annealed as in the example after Fig. , a verschleissfeste film 5 for the example from titanium nitride or titanium carbide of a thickness of 6 mu m vapor deposited described 1.

With the method according to invention engraved rollers and panels with finest engraving samples, for the example know 40000 holes on 1 cm< 2> ever approx. 16 mu m deeply, reproducibly with surface hardness starting from 2000 HV depending upon selected hard material for the wear course to be manufactured. Such engravings are needed variously for the example of engraving and coating rollers for printing processes. Cleaning, polishing and pretreatment steps are implemented as required in well-known way.